Ultrawideband Communications

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Intelligence operations require short-range wireless communications systems capable of collecting data rapidly and transmitting it covertly and reliably. Such systems must be robust; have a low probability of detection and intercept; employ low-power, small-size hardware; and interface easily with other systems for analysis or to establish long-distance links. Commercial communication systems operate in fixed frequency bands and are easily detectable and are prone to jamming by the enemy, among other shortcomings.

We are focusing on the three key operational modes for the Department of Defense and the intelligence community: 1) secure sensor and voice communications over a 1-km range; 2) ground-to-ground and air-to-ground data channels for small, unmanned air vehicles; and 3) network communication for large numbers of sensors in a local area, including multipath and extremely low-altitude operations.

The goal of this project is to develop and demonstrate 1) ultra-wideband (UWB) communication with a capacity of 5 Mbps and a range of 1 km; 2) multichannel capability with sensors; 3) a test bed for application development; and 4) performance standards for bit error rate and low probabilities of detection and intercept.

In FY02, we built several UWB communication transceivers for voice, video, and digital-data communications for intelligence applications (see figure). We also performed modeling and propagation analyses with multiple channels and developed 1) a UWB radio with a capacity of 2 Mbps, a range of 160 m, two channels, and a power requirement of <1 W; 2) a graphical user interface for these models; 3) an interface for real-time applications; and 4) a network and architecture design. In addition, arrays of transmitters for covert communications were computationally modeled and simulated, and preliminary testing of the UWB communications device was conducted.

For FY03, we plan to 1) complete the modeling and propagation analysis for mobility and multipath capabilities; 2) design and implement a reconfigurable, integrated network for about ten UWB radios, including the application-layer infrastructure; 3) further refine our robust 5-Mbps, 1-km-range system to operate on <0.5 W with 10 channels, including a mobile channel; 4) develop a transmitter array for extreme covert communications; and 5) submit papers on propagation, architecture, and performance to peer-reviewed publications.
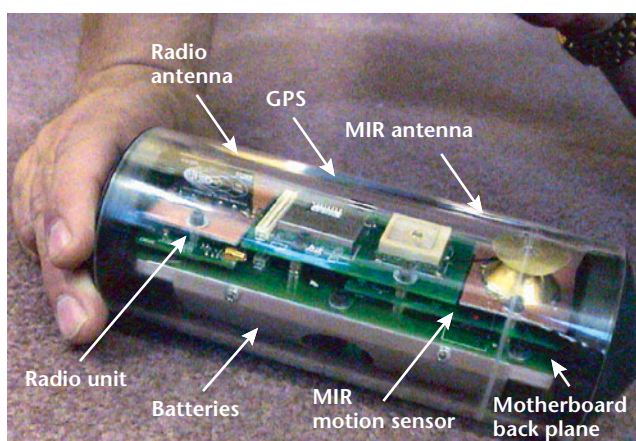
Compact sensor node, equipped with an antenna, global positioning system (GPS), UWB radar, micropower impulse radar (MIR), processing unit, and batteries. Network protocols were developed to interface with our UWB radio design. Sensor radio nodes of this type will play a critical role in modern wireless sensor networks for intelligence and battlefield applications.